65 Tire, Wheel, and Wheel Bearing Fundamentals

After studying this chapter, you will be able to:

- Identify the parts of a tire and wheel.
- Describe different methods of tire construction.
- Explain tire and wheel sizes.
- Describe tire ratings.
- Identify the parts of driving and nondriving hub and wheel bearing assemblies.
- Correctly answer ASE certification test questions requiring a knowledge of tires, wheels, hubs, and wheel bearings.

This chapter introduces the various tire, wheel, and hub designs used on modern vehicles. It explains how tires and wheels are constructed to give safe and dependable service. The chapter also covers hub and wheel bearing construction for both rear- and front-wheel-drive vehicles. As a result, you will be better prepared to study later chapters on brakes, suspension systems, and wheel alignment.

Tires

Automobile ***tires*** perform two basic functions: they act as a soft *cushion* between the road and the metal wheel, and they provide adequate *traction* (friction) with the road surface.

Tires must transmit driving, braking, and cornering forces to the road in both good and bad weather. At the same time, they should resist punctures and wear.

The tires used on early vehicles were solid rubber. Today's automotive tires are ***pneumatic,*** which means they are filled with air. Internal air pressure pushes out on the inside of the tire to support the weight of the vehicle.

Today's vehicles use ***tubeless tires,*** which do *not* have a separate inner tube. The tire and wheel form an airtight unit. Refer to **Figure 65-1.** Older vehicles used ***inner tubes*** (soft, thin, leakproof rubber liners) that fit inside the tire and wheel assemblies.

Parts of a Tire

Although there are several tire designs, all tires have the same basic parts, **Figure 65-2:**

- ***Beads***—Two rings that are made of steel wire and encased in rubber. They hold the tire sidewalls snugly against the wheel rim.
- ***Body plies***—Rubberized fabric and cords wrapped around the beads. They form the carcass, or body, of the tire.
- ***Tread***—Outer surface of the tire that contacts the road.
- ***Sidewall***—Outer part of the tire that extends from the bead to the tread. Markings on the sidewall provide information about the tire.
- ***Belts***—Sometimes used to strengthen the body plies and stiffen the tread. They lie between the tread and plies.
- ***Liner***—Thin layer of rubber that is bonded to the inside of the plies. It provides a leakproof membrane for the modern tubeless tire.

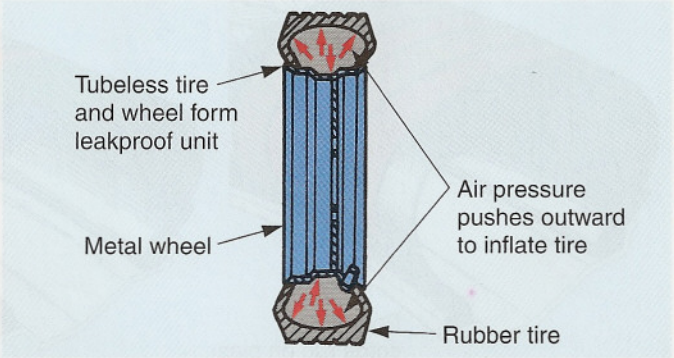

Figure 65-1. With tubeless tires, the tire and wheel form a leakproof unit. Air pressure pushes outward on the inside of the tire.

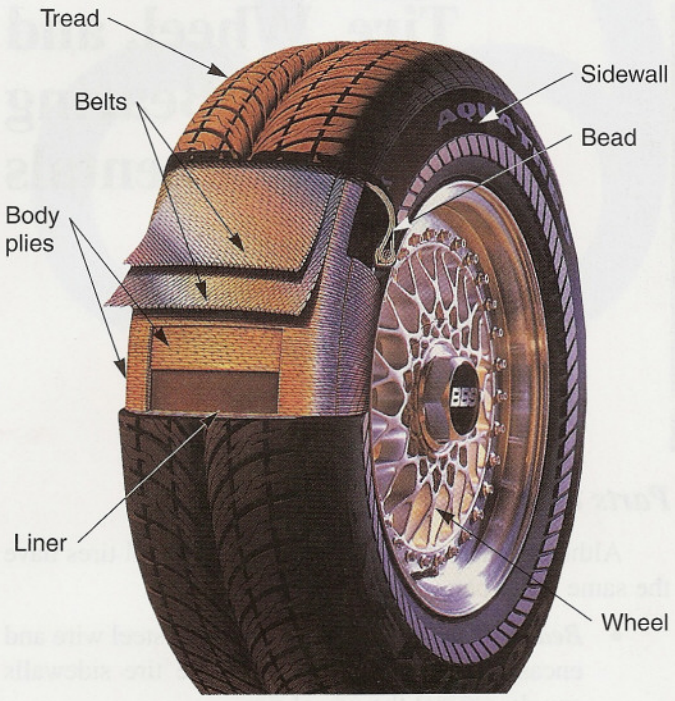

Figure 65-2. Study the basic parts of a tire. (Goodyear)

Tire Rolling Resistance

Tire rolling resistance is a measurement of the amount of friction produced as the tire operates on the road surface. A high rolling resistance would increase fuel consumption and wear. Typically, rolling resistance is reduced by higher inflation pressure, proper tire design, and lower vehicle weight.

Tire Construction

There are many construction and design variations in tires. A different number of plies may be used. The plies may run at different angles. Also, different materials may be utilized.

Three types of tires found in use today are the bias ply tire, belted bias tire, and radial tire.

Bias Ply Tire

In a ***bias ply tire,*** the plies run at an angle from bead to bead. The angle is reversed from ply to ply. The tread is bonded directly to the top ply. See **Figure 65-3A.**

A bias ply tire is one of the oldest designs, and it does *not* use belts. The position of the plies in a bias ply tire allows the body of the tire to flex easily. This tends to improve cushioning action. A bias ply tire provides a very smooth ride on rough roads.

One disadvantage of the bias ply tire is the weakness of the plies and tread, which reduces traction at high speeds and increases rolling resistance.

Belted Bias Tire

A ***belted bias tire*** is a bias ply tire with belts added to increase tread stiffness. The plies and belts normally run at different angles. The belts do *not* run around to the sidewalls—they lie under the tread area only. Usually, two stabilizer belts and two or more plies are used to improve tire performance. Look at **Figure 65-3B.**

A belted bias tire provides a smooth ride and good traction. It also offers some reduction in rolling resistance over a bias ply tire.

Radial Ply Tire

A ***radial ply tire*** has plies running straight across from bead to bead, with stabilizer belts directly beneath the tread. The belts can be made of steel, flexten, fiberglass, or other materials. A typical radial tire is illustrated in **Figure 65-3C.**

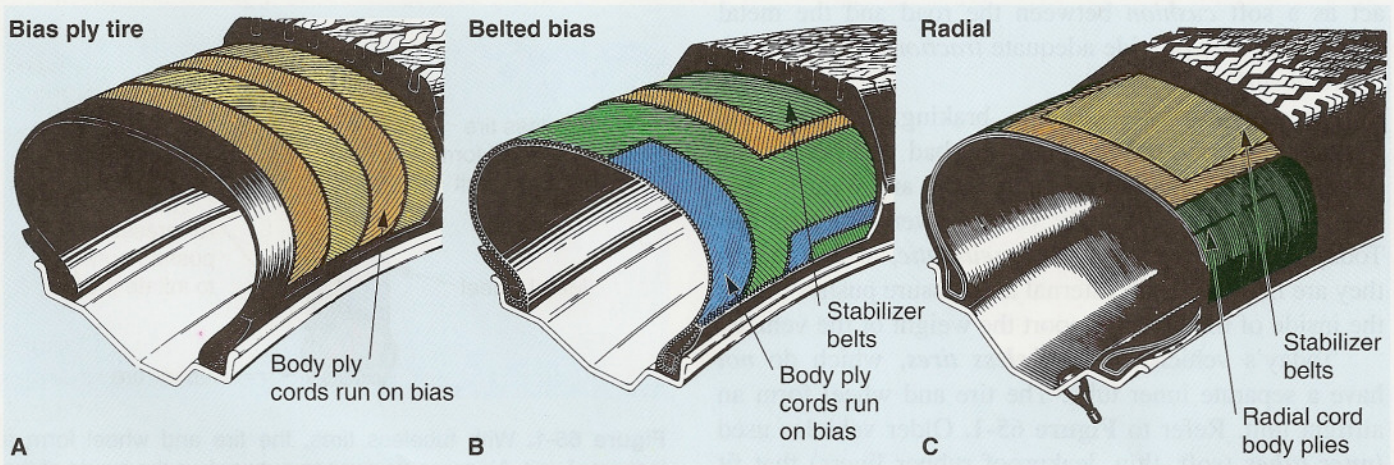

Figure 65-3. There are three basic tire types. A—Bias ply tire B—Belted bias tire. C—Radial ply tire. (Firestone)

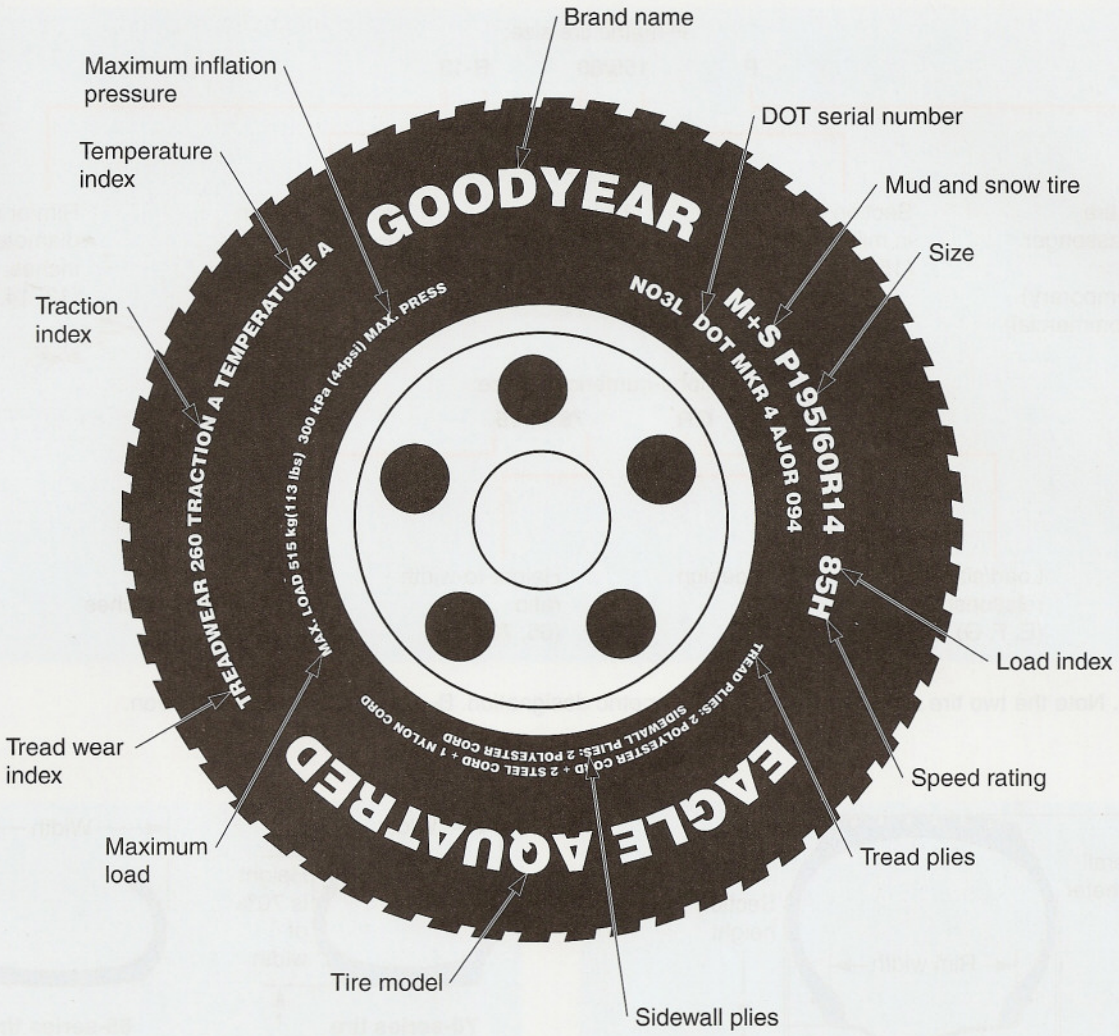

Figure 65-4. Sidewall markings contain information about a tire. Study the sidewall markings on this tire.

A radial tire has a very flexible sidewall *and* a stiff tread, giving it a very stable ***footprint*** (shape and amount of tread touching road surface). This improves safety, cornering, braking, and wear.

One possible disadvantage of a radial tire is that it may produce a harder, or harsher, ride at low speeds. The stiff tread area does *not* give or flex as much on rough roads.

Tire Markings

Tire markings on the sidewall of a tire give information about tire size, tire model, load-carrying ability, inflation pressure, number of plies, speed rating, manufacturer, etc. It is important that you understand these tire markings. Refer to **Figure 65-4.**

Tire Size

Tire size is given on the sidewall as a letter-number sequence. There are two common size designations: alpha-numeric (conventional measuring system) and P-metric (metric measuring system).

The ***P-metric*** size designation is the newest tire identification system. It uses metric values and international standards. Look at **Figure 65-5A.**

The letter "P" indicates that the tire is designed for use on a passenger car. The first number, 155, gives section width in millimeters. The second number, 80, is the aspect ratio (height-to-width ratio). The R indicates radial (B means belted bias and D means bias ply). The last number, 13, shows the rim diameter in inches (not metric values).

The ***alpha-numeric*** (alphabetical-numerical) tire size designation uses letters and numbers to denote tire size in inches and its load-carrying capacity in pounds. An example is given in **Figure 65-5B.**

The first letter, G, indicates the load and size relationship. The higher the letter, the larger the size and load-carrying ability of the tire. G is smaller than H, for example. The second letter, R, means that the tire is a radial. Bias and belted bias tires do not have a second letter. The first number, 78, is the aspect, or

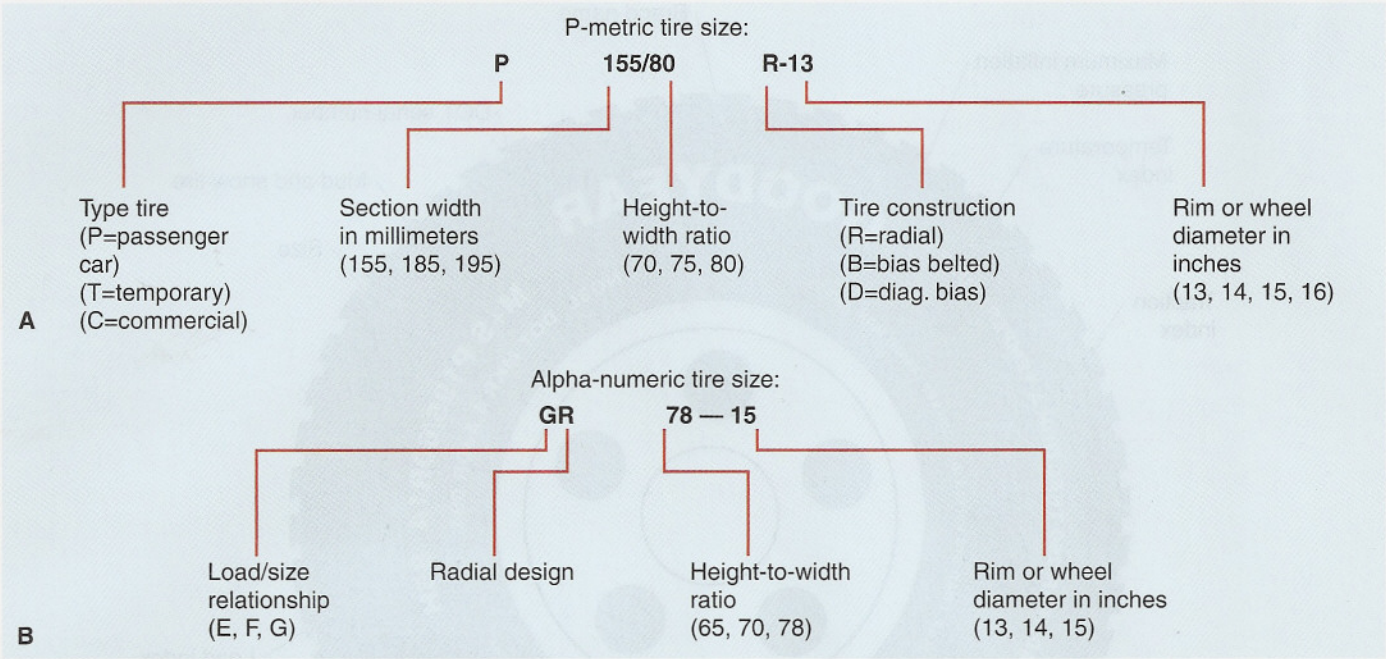

Figure 65-5. Note the two tire size designations. A—P-metric designation. B—Alpha-numeric designation.

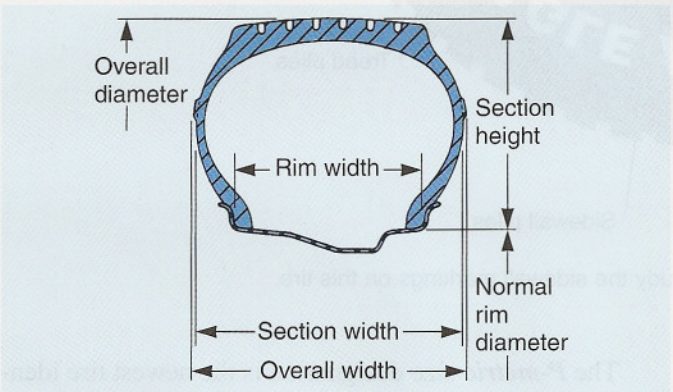

Figure 65-6. Points of measurement on a tire. These dimensions are important when ordering new tires or wheels. (B.F. Goodrich)

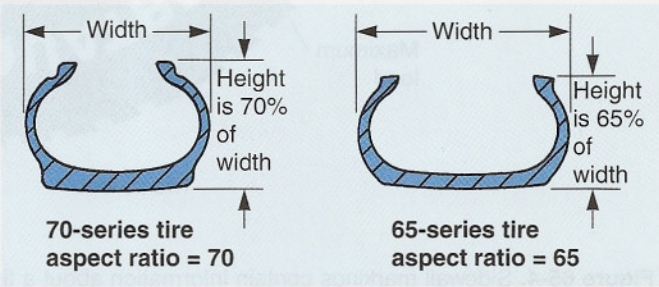

Figure 65-7. The aspect ratio is the height-to-width ratio of tire. Note that a 65 series tire is wider and shorter than a 70 series tire.

height-to-width, ratio. The last number, 15, is the rim diameter in inches. The points of measure for a tire are given in **Figure 65-6.**

Aspect Ratio

The ***aspect ratio,*** or height-to-width ratio, in the tire size designation is the most difficult value to understand. See **Figure 65-7.**

Note that, as the number becomes smaller, the tire becomes more ***squat*** (wider and shorter). The aspect ratio is the comparison of the tire's height (bead-to-tread distance) and width (sidewall-to-sidewall distance).

A 70-series tire, for example, has an aspect ratio of 70; the height of the tire is 70 percent of the width. A 60 series tire would be "short" and "fat." A 78 tire would be "narrow" and "tall."

Maximum Load Rating

The ***maximum load rating*** of a tire indicates the amount of *weight* the tire can carry at the recommended inflation pressure. The maximum load value—1500 pounds, for example—is printed on the sidewall.

With P-metric tire designations, the load rating is simply given in kilograms and pounds. The alpha-numeric load rating is indicated by a letter. Most alpha-numeric size tires are load range B. They are restricted to the load specified at 32 psi (220 kPa). Where a greater load carrying ability is needed, load range C or D tires are used.

Maximum Inflation Pressure

The ***maximum inflation pressure*** is the highest air pressure that should be pumped into the tire. Many tires have a maximum recommended inflation pressure of 32 psi (220 kPa). However, tires with higher load ranges can hold higher pressures and carry more weight.

Tread Plies

The tire sidewall also includes information on the number of plies and ply rating. For example, the tire may be a 2-ply tire, a 2-ply with a 4-ply rating (plies made stronger than normal), or a 4-ply tire. A greater number of plies or a higher ply rating generally indicates a greater load-carrying ability.

Sidewall Plies

The number of sidewall plies is also shown on the tire sidewall.

DOT Serial Number

DOT stands for *Department Of Transportation*. When you see "DOT" on the tire sidewall, the tire has passed prescribed safety tests.

Following the letters DOT is the ***DOT serial number,*** which identifies the particular tire manufacturer, plant location, construction, and date of manufacture. The DOT serial number is stamped into the tire sidewall.

Tire Grades

Tread wear, traction, and temperature grades are normally shown on the tire sidewall according to the Uniform Tire Quality Grading System.

Tread wear is given as a number. Tread wear ratings range from 100 to 500. The higher the number, the more resistant the tire is to wear.

Tire traction is given an A, B, or C rating. A tire with an A rating would provide the most traction, while a tire with a C rating would provide the least traction.

Tire temperature resistance is also given as an A, B, or C rating. A tire with an A rating resists a temperature buildup better than a tire with a B or C rating.

Speed Rating

A ***tire speed rating*** is the maximum allowable sustained road speed a tire can safely withstand without failure. Speed ratings range from B (31 mph or 50 km/h) to Z (149 mph or 238 km/h).

It is important that the speed rating of a tire be higher than the speed at which the vehicle will be driven. If too low a speed rating is used, the tire could fail and cause a fatal accident. This is extremely important if the vehicle is to be driven in areas where there is no speed limit (some states and foreign countries).

Special Tires and Tire Features

You should be familiar with several types of special tires and tire features. The automotive technician will encounter compact spare tires, self-sealing tires, retreads, and run-flat tires.

Asymmetric Tires

Asymmetric tires have a different tread pattern on the inner edge than the outer edge. The outer tread pattern is designed to improve cornering on dry surfaces. The inner tread pattern is designed to improve traction on wet surfaces. An asymmetric tire must be mounted so the proper edge faces the outside of the wheel. This type of tire is generally marked with the word *outside* to indicate which way it should be mounted on the wheel.

Directional Tires

Directional tires are high-performance tires designed to rotate in a specific direction to minimize hydroplaning. ***Hydroplaning*** is a loss of control that occurs when layer of water prevents the tire tread from contacting the road surface. Directional tires have an arrow and the word *rotation* molded onto their sidewalls. Care must be taken to mount directional tires in the proper location so they rotate in the desired direction.

Spare Tires

A ***spare tire,*** or spare, is an extra wheel and tire assembly that can be installed if the vehicle has a flat tire. The spare can be a full-size tire or a compact tire.

A ***full-size spare*** is a tire of the same size and type used on the other four wheels of the vehicle. It can be mounted and used like any other tire. It is being replaced by compact, lighter spare tires.

Most new cars use a ***compact spare tire,*** or ***space saver spare,*** which is much smaller than the normal tire used on the vehicle. It saves space in the trunk or storage area. See **Figure 65-8.**

A ***high-pressure spare*** is a compact spare tire that holds higher-than-normal air pressure (typically about 60 psi). It is inflated when in the trunk and is ready for use.

Some spare tires are *not* inflated when in storage. A small bottle of compressed air may be used to inflate the tire when needed.

A ***lightweight spare tire*** has very thin sidewall and tread construction. Being light, it can be more easily picked up and mounted on the vehicle. However, the driving range and maximum speed rating of a lightweight spare are generally lower than those for a compact spare.

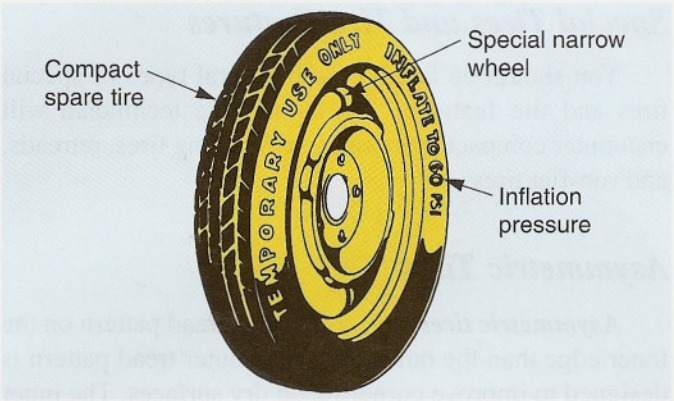

Figure 65-8. A compact spare tire is for temporary use only. This one should be inflated to 60 psi (415 kPa). It requires a special narrow wheel. (Oldsmobile)

Tech Tip!
Most modern spare tires are designed for *temporary use only.* Refer to the manufacturer's specifications on inflation pressure, maximum driving speed, and the number of miles that can be driven. Most compact spares should not be used at speeds over 50 mph and will last only a few thousand miles.

Self-Sealing Tires

Some tires are ***self-sealing*** (seal small punctures). These tires have a coating of sealing compound applied to their liners. If a nail punctures a self-sealing tire, air pressure will push the soft compound into the hole to stop air leakage. Refer to **Figure 65-9.**

Retreads

Retreads are used tires that have had a new tread vulcanized (applied using heat and pressure) to the old carcass, or body. Retreads, also called recaps, are seldom used on passenger cars. However, large truck tires are frequently recapped because of the high cost of new truck tires.

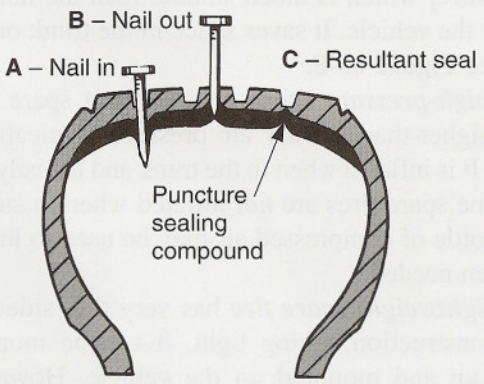

Figure 65-9. Self-sealing tire action. A—Nail punctures the tire. B—Nail is pulled out. C—Sealing compound flows into the hole to prevent air from leaking out. (GMC)

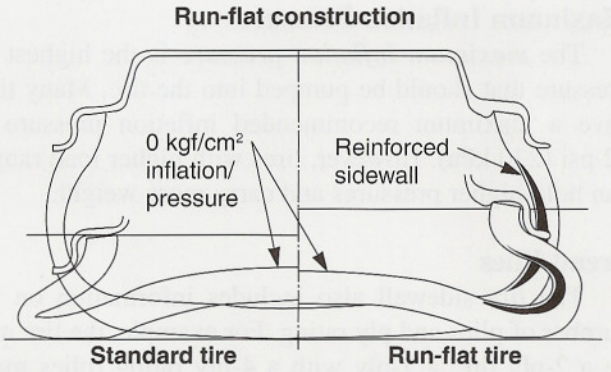

Figure 65-10. Compare the construction of a run-flat tire to that of a conventional tire. (Bridgestone)

Run-Flat Tires

Run-flat tires have an extremely stiff sidewall construction so that they are still usable with a loss of air pressure. If the tire leaks, you can drive the vehicle to a repair shop without tire and wheel damage. See **Figure 65-10.**

The tire will retain most of its shape because the sidewall is strong enough to support vehicle weight. The tire uses a special rubber compound and a thick rubber sidewall support insert that helps support the weight of the vehicle.

Wear Bars

Wear bars are used to indicate a critical amount of tread wear. When too much tread has worn from the tires, solid rubber bars will show up across the tread. This tells the customer and the technician that tire replacement is needed. Look at **Figure 65-11.**

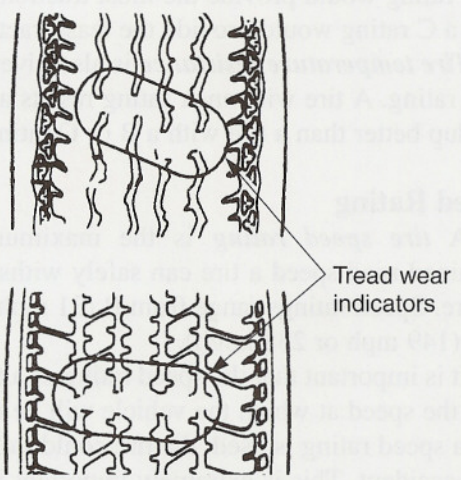

Figure 65-11. When wear bars are visible, a tire is worn enough to be unsafe and should be replaced. (General Motors)

Tire Pressure Monitoring Systems

Many late-model vehicles are equipped with ***tire pressure monitoring systems***, which alert the driver if one or more of the vehicle's tires is underinflated. There are two types of tire inflation systems used in late-model vehicles: direct systems and indirect systems.

Direct tire pressure monitoring systems use a pressure sensor/transmitter mounted at each wheel. In some cases, these sensors are attached to the tire valves. In other designs, the sensors are held to the wheel with a metal or plastic strap. See **Figure 65-12**. If the tire pressure drops below a predetermined value, the sensor on the corresponding wheel will send a signal to a small receiver mounted in the passenger compartment. The receiver then turns on a dash warning light to inform the driver of the inflation problem. See **Figure 65-13**.

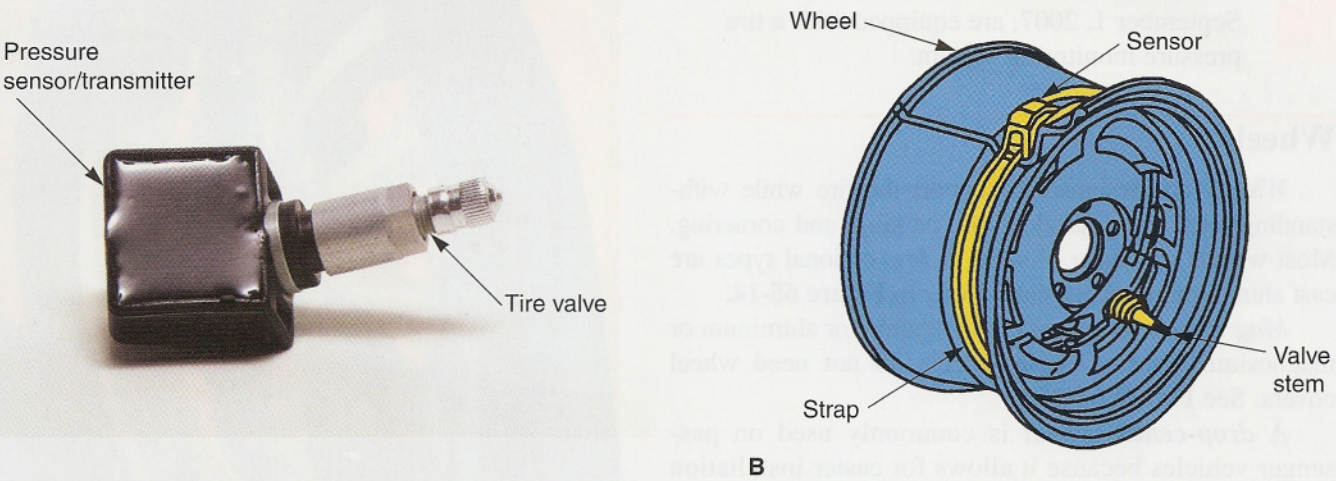

Figure 65-12. Some tire pressure monitoring systems use a pressure sensor/transmitter mounted at each wheel. A—Valve-mounted sensor. B—This sensor is strapped to the inside of the wheel. (Ford, Chevrolet)

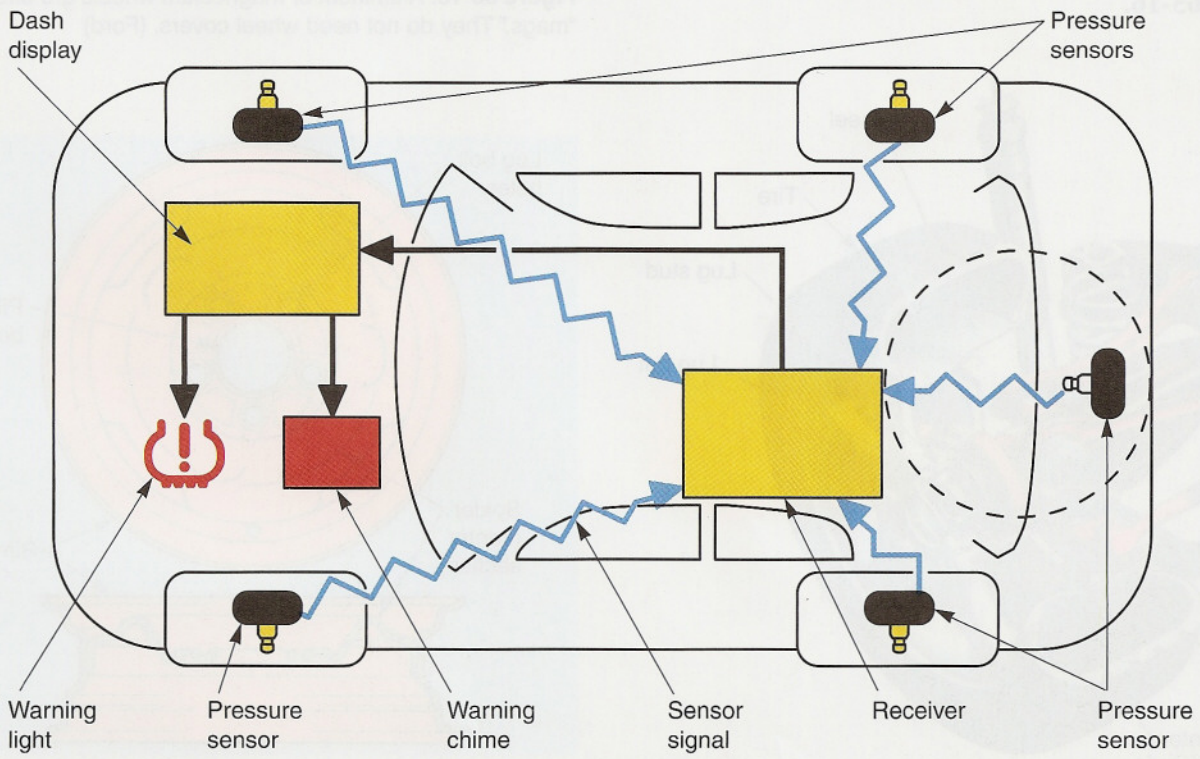

Figure 65-13. If one of the pressure sensor/transmitters detects low tire pressure, it will produce a radio signal. A receiver in the passenger compartment detects the signal and triggers a warning light in the dash. (Toyota)

In an indirect tire pressure monitoring system, the anti-lock brake system components are used to monitor tire pressure. When pressure in a tire drops, the tire's circumference is reduced. This causes the wheel and tire assembly to spin faster than the other tires. The computer interprets the speed sensor signal from the affected wheel as a drop in tire pressure and triggers a warning light.

Note!
All vehicles with a gross vehicle weight rating of less than 10,000 lb sold on or after September 1, 2007, are equipped with a tire pressure monitoring system.

Wheels

Wheels are designed to support the tire while withstanding loads from acceleration, braking, and cornering. Most wheels are made of steel. A few optional types are cast aluminum or magnesium. Refer to **Figure 65-14.**

Mag wheels, or ***mags,*** is a nickname for aluminum or magnesium wheels. These wheels do not need wheel covers. See **Figure 65-15.**

A ***drop-center wheel*** is commonly used on passenger vehicles because it allows for easier installation and removal of the tire. Since the center of the wheel is smaller in diameter (dropped) than the rim, the tire bead can fall into the recess. Then, the other side of the tire bead can be forced over the rim for removal. See **Figure 65-16.**

A standard wheel consists of the ***rim*** (outer lip that contacts tire bead) and the ***spider*** (center section that bolts to vehicle hub). Normally, the spider is welded to the rim.

Figure 65-17 illustrates the various dimensions of a wheel. Compare this illustration with **Figure 65-16.**

Figure 65-15. Aluminum or magnesium wheels are often called "mags." They do not need wheel covers. (Ford)

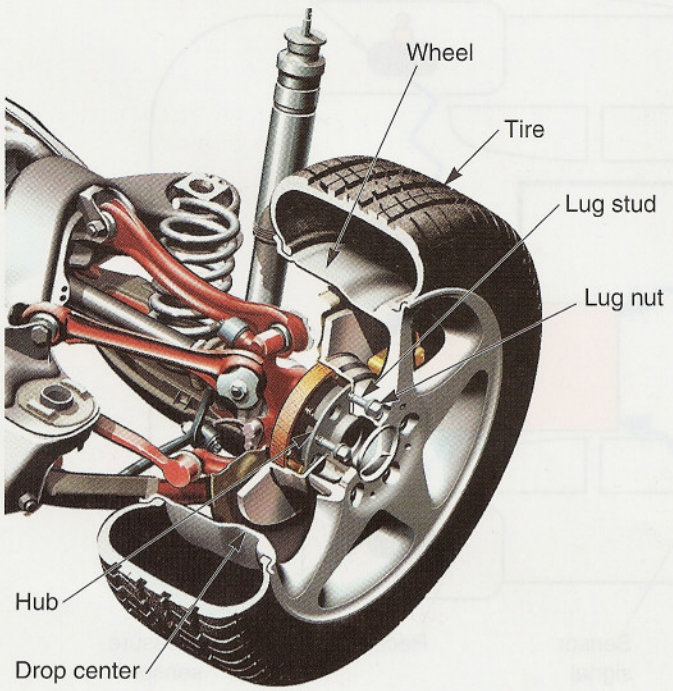

Figure 65-14. Cutaway shows many of the components relating to a wheel. (Mercedes Benz)

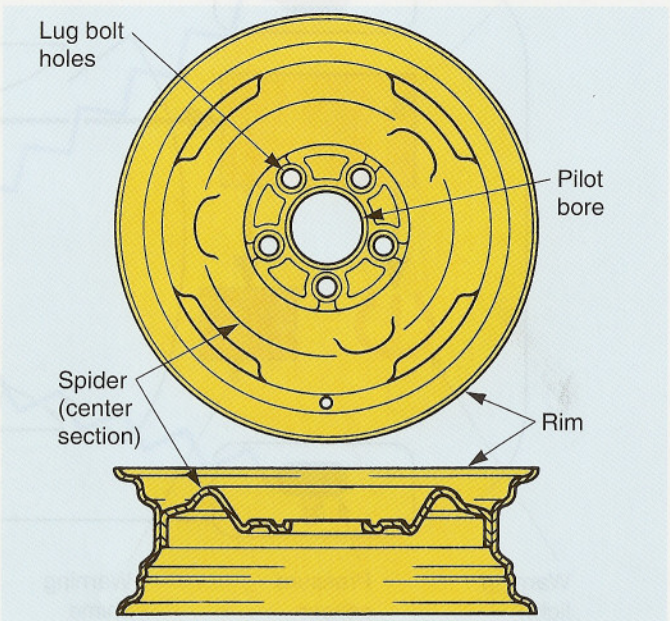

Figure 65-16. Study the parts of this conventional drop-center wheel.

Safety Rims

A ***safety rim*** has small ridges that hold the tire beads on the wheel during a tire ***blowout*** (instant rupture and air loss) or a ***flat*** (slow leak reduces inflation pressure).

Small raised lips around the rim keep the tire beads from sliding into the drop-center section. This improves safety by keeping the tire from coming off the wheel. See **Figure 65-18.**

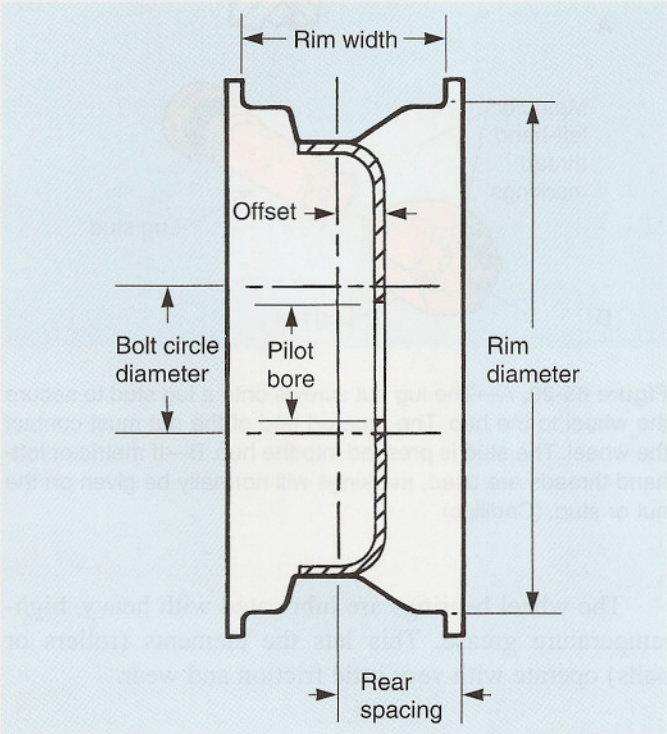

Figure 65-17. Study the basic dimensions of a wheel. (Goodyear)

Valve Stems and Cores

A ***valve stem*** is pressed into a hole in the wheel of a tubeless tire to allow inflation and deflation. The stem is made of rubber. A threaded metal tube is formed in the end of the stem. **See Figure 65-19.**

The ***valve core*** is a spring-loaded air valve that is threaded into the valve stem, **Figure 65-19.** The valve core allows air to be added to the tire when an ***air chuck*** (tool for filling tire with air) is placed over the valve stem. When the air chuck is removed from the valve stem, the spring pushes the valve closed to prevent air leakage.

To remove air from the tire, push the center of the valve core inward. The valve will open, allowing air to escape. A ***valve stem cap*** screws over the threaded valve stem to protect the air valve and stem threads from dirt, moisture,

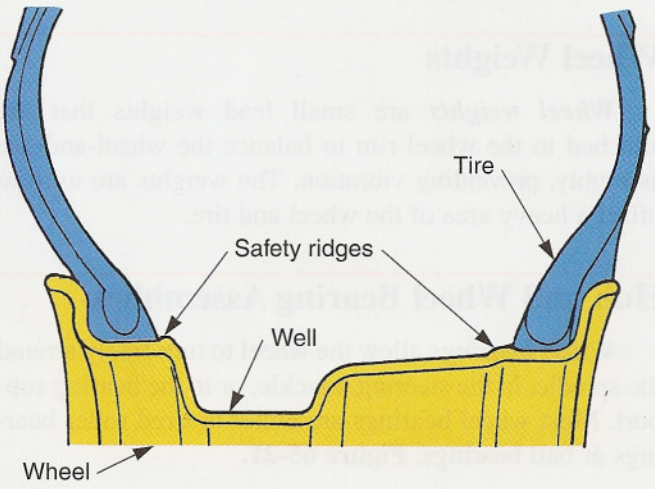

Figure 65-18. Safety ridges prevent the tire from dropping into the center well in the event of a flat or a blowout. (DaimlerChrysler)

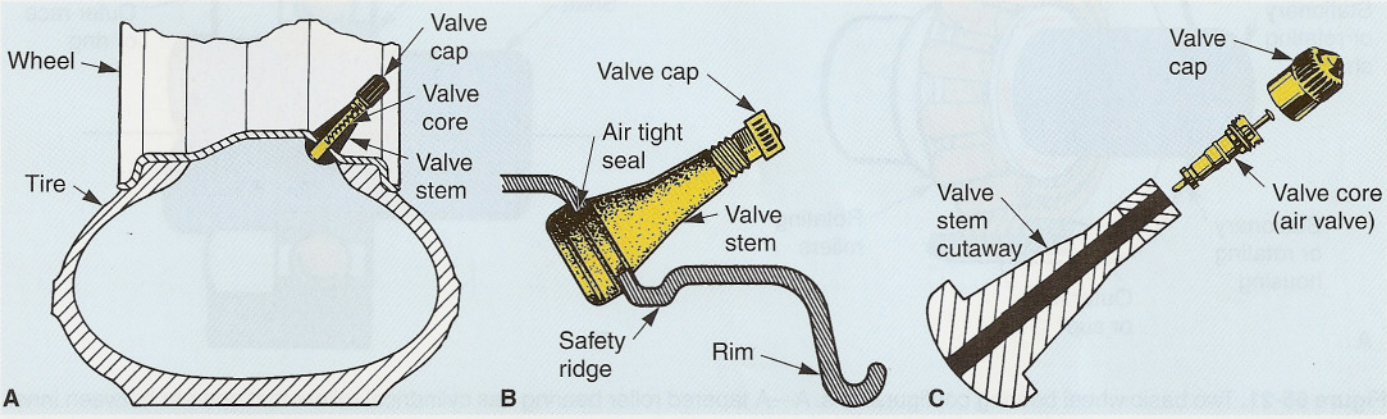

Figure 65-19. A—Valve stem snaps into a hole in the wheel. B—The press fit between the stem and the wheel forms an airtight seal. C—The valve core is an air valve that screws into the valve stem body. The valve cap screws over the end of the stem. (Toyota)

and damage. It also helps prevent accidental depression of the valve and the resulting loss of air pressure.

Lug Nuts, Studs, and Bolts

Lug nuts hold the wheel and tire assembly on the vehicle. They fasten to special studs. The inner face of the lug nut is tapered to help center the wheel on the hub. Refer to **Figure 65-20A.**

Lug studs are the special studs that accept the lug nuts. The studs are pressed through the back of the hub or axle flange. See **Figure 65-20B.**

Normally, the lug nuts and studs have right-hand threads (turn clockwise to tighten). When left-hand threads are used, the nut or stud will be marked with an "L." Metric threads will be identified with an "M" or the word "Metric."

A few cars use ***lug bolts*** instead of lug nuts. The bolts screw into threaded holes in the hub or axle flange.

Wheel Weights

Wheel weights are small lead weights that are attached to the wheel rim to balance the wheel-and-tire assembly, preventing vibration. The weights are used to offset a heavy area of the wheel and tire.

Hub and Wheel Bearing Assemblies

Wheel bearings allow the wheel to turn freely around the spindle, in the steering knuckle, or in the bearing support. Most wheel bearings are either tapered roller bearings or ball bearings, **Figure 65-21.**

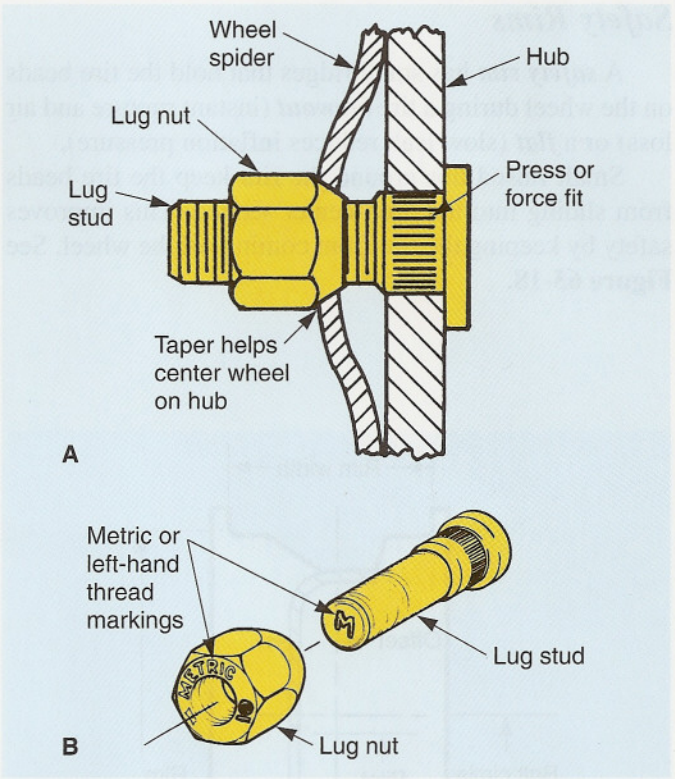

Figure 65-20. A—The lug nut screws onto a lug stud to secure the wheel to the hub. The tapered end of the nut must contact the wheel. The stud is pressed into the hub. B—If metric or left-hand threads are used, markings will normally be given on the nut or stud. (Cadillac)

The wheel bearings are lubricated with heavy, high-temperature grease. This lets the elements (rollers or balls) operate with very little friction and wear.

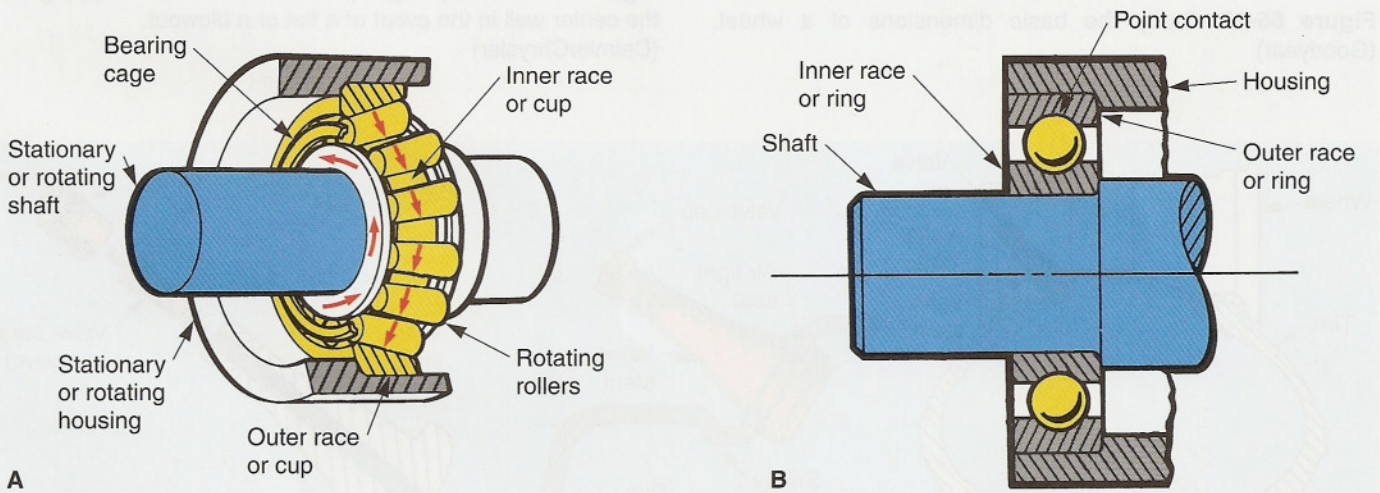

Figure 65-21. Two basic wheel bearing configurations. A—A tapered roller bearing has cylindrical rollers that operate between inner and outer races. If the shaft is stationary, the bearing will allow the outer housing or hub to turn. If outer bearing mount is stationary, the shaft or axle can turn in the bearing. B—Ball bearings are also used as wheel bearings, especially on a vehicle's driving wheels. The balls allow parts to rotate with a minimum amount of friction and wear. (Federal Mogul)

The basic parts of a wheel bearing are:

- ***Outer race***—cup or cone pressed into hub, steering knuckle, or bearing support.
- ***Balls or rollers***—antifriction elements that fit between inner and outer races.
- ***Inner race***—cup or cone that rests on spindle or drive axle shaft.

There are two basic hub and wheel bearing assembly designs: those with tapered roller bearings and those with ball or straight roller bearing assemblies.

Hub and Wheel Bearing Assembly—Tapered Roller Bearings

Tapered roller bearings can be used on both driving and non-driving. The basic parts found in a hub and tapered roller bearing assembly for a vehicle's non-driving wheels are illustrated in **Figure 65-22**. These parts include:

- ***Spindle***—stationary shaft extending outward from the steering knuckle or the suspension system.
- ***Wheel bearings***—tapered roller bearings mounted on the spindle and in the wheel hub.
- ***Hub***—outer housing that holds the brake disc or drum, front wheel, grease, and wheel bearings.

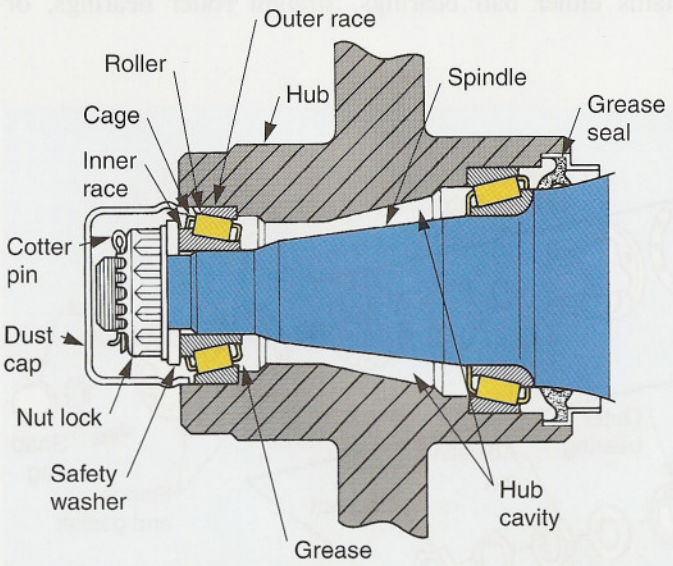

Figure 65-22. Typical non-driving, or freewheeling, hub and wheel bearing assembly for the front or rear of a car. Two tapered roller bearings allow the hub and wheel to revolve around the stationary spindle. Grease partially fills the hub to lubricate the bearings. An inner seal prevents the loss of grease. A nut on the end of the spindle allows adjustment of the bearing preload. (DaimlerChrysler)

- ***Grease seal***—seal that prevents the loss of lubricant from the inner end of the spindle and hub.
- ***Safety washer***—flat washer that keeps the outer wheel bearing from rubbing on and turning the adjusting nut.
- ***Spindle adjusting nut***—nut that is threaded on end of the spindle for adjusting the wheel bearing.
- ***Nut lock***—thin, slotted nut that fits over the spindle adjusting nut.
- ***Cotter pin***—soft metal pin that fits through a hole in the spindle, adjusting nut, and nut lock to keep the adjusting nut from turning in service.
- ***Dust cap***—metal cap that fits over the outer end of the hub to keep grease in and road dirt out of bearings.

Since this hub and wheel bearing assembly does *not* transfer driving power, the spindle is stationary. It simply extends outward and provides a mounting place for the wheel bearings, hub, and wheel. When the vehicle is moving, the wheel and hub spin on the bearings and spindle. The hub simply freewheels. The hub is partially filled with grease to lubricate the bearings.

Figure 65-23 shows a disassembled view of a non-driving front bearing and hub assembly. Compare these parts to the ones in **Figure 65-22.**

Figure 65-24 shows the front drive hub and wheel bearing assembly for a four-wheel-drive vehicle. Note that it has a driving axle that extends through a stationary spindle. A special free-wheel, or locking, hub transfers power from the axle to the hub-disc assembly.

Hub and Wheel Bearing Assembly—Ball or Straight Roller Bearings

Ball bearings and straight roller bearings are often used at both driving and non-driving wheels. In most cases, the bearings are part of an assembly that includes the inner and outer races. The assembly is pressed into the steering knuckle or support.

Figure 65-25 illustrates the basic parts found in a hub and wheel bearing assembly for the driving wheel of a front-wheel-drive vehicle. These parts include:

- ***Outer drive axle***—stub axle shaft that extends through the bearings and is splined to the hub.
- ***Ball bearings***—antifriction elements that allow the drive axle to turn in the steering knuckle or bearing support.

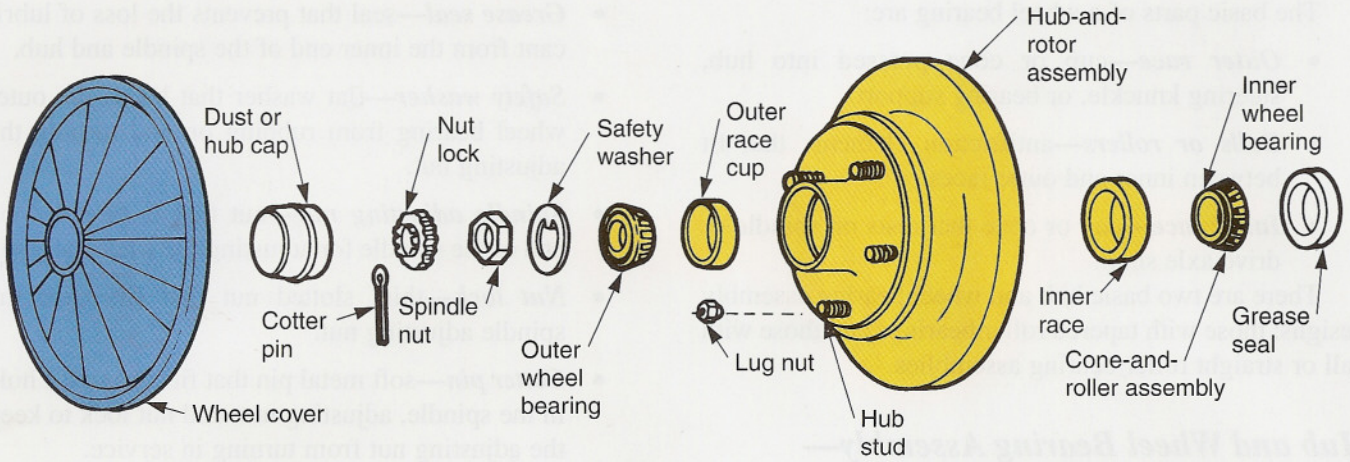

Figure 65-23. Disassembled view of a nondriving hub and wheel bearing assembly. Note the part names and relationships. This type of assembly can be used on the front of rear-wheel-drive cars or the rear of front-wheel-drive vehicles. (Florida Dept. of Voc. Ed.)

- ***Steering knuckle*** or ***bearing support***—steering or suspension component that holds the wheel bearings, axle stub shaft, and hub.
- ***Driving hub***—mounting place for the wheel; transfers driving power from the stub axle to the wheel.
- ***Axle washer***—special washer that fits between the hub and locknut.
- ***Hub*** or ***axle locknut***—nut that screws on the end of the drive axle stub shaft to secure the hub and other parts of assembly.
- **Grease seal**—prevents lubricant loss between the inside of the axle and the knuckle or bearing support.

Figure 65-26 shows an exploded view of another type of driving hub and wheel bearing assembly. Compare it to **Figure 65-25.**

Other Hub and Wheel Bearing Assemblies

Modern vehicles use a wide variation of hub and wheel bearing assemblies. For example, many late-model vehicles use a sealed hub and bearing assembly that contains either ball bearings, straight roller bearings, or

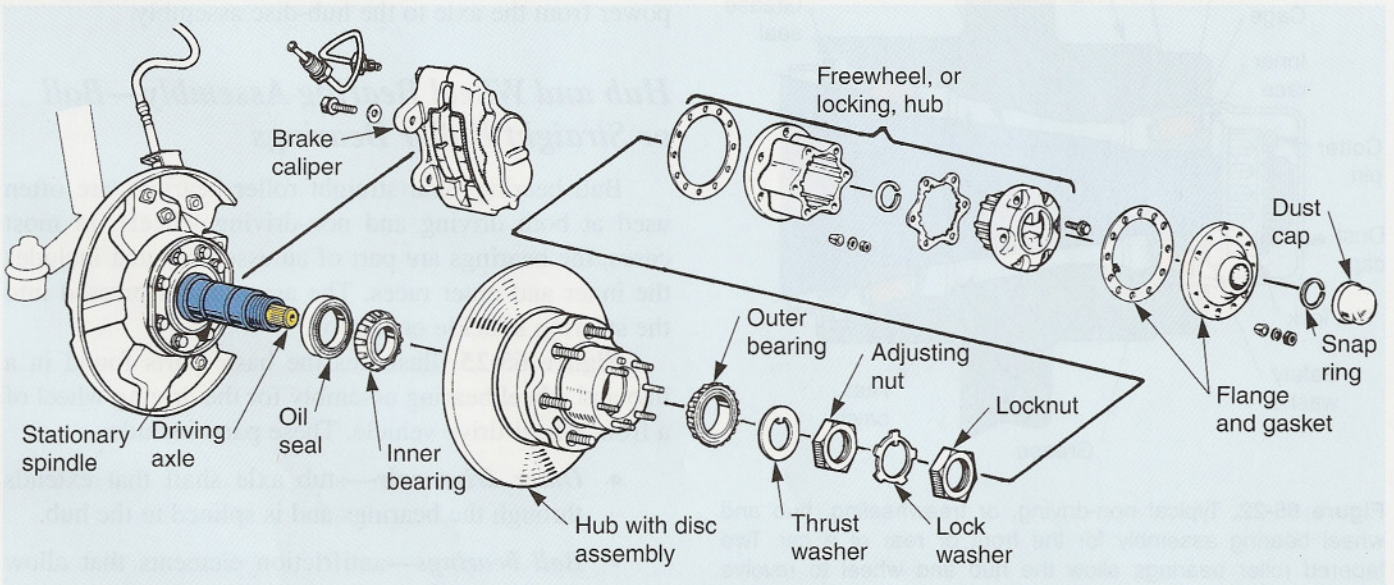

Figure 65-24. This front hub and wheel bearing assembly is used in a four-wheel-drive vehicle. Compare this unit to those shown earlier. Note how the drive axle sticks through a stationary spindle. An adjustable hub allows the drive axle to be connected and disconnected from the hub and wheel assembly for two- or four-wheel-drive operation. (Toyota)

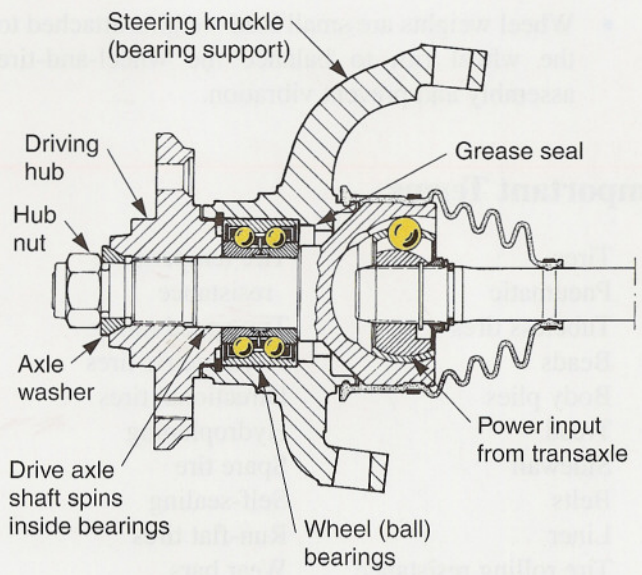

Figure 65-25. Driving hub and wheel bearing assembly has bearings mounted in a stationary steering knuckle or a bearing support. The drive axle shaft fits through the center of the bearings. The hub is splined to axle shaft. The ball bearings are lubricated by thick, high-temperature grease.

tapered roller bearings. These self-contained units are not serviceable. In most cases, they are bolted to the knuckle or support. A few are press fit into the knuckle.

When you need more information on a specific vehicle, always refer to the factory service manual. It will explain and illustrate the hub and wheel bearing assembly clearly. Most designs, however, will be similar.

Note!
Ball bearings and straight roller bearings are often used in solid rear drive axle assemblies to reduce friction between the axles and the housing. Detailed information on rear axle bearings can be found in Chapter 61, *Differential and Rear Drive Axle Fundamentals,* and Chapter 62, *Differential and Rear Drive Axle Diagnosis and Repair.*

Highway History

Although Michelin introduced the first steel-belted radial tire in 1948, radial tires were not standard on American vehicles until many years later. In fact, it was not until the gasoline crisis of the early 1970's that American manufacturers began the switch to radial tires as a way to improve fuel economy. By 1983, radial tires were standard equipment on all new American passenger cars.

Summary

- Automobile tires perform two basic functions: they act as a soft *cushion* between the road and the metal wheel. Tires must also provide adequate *traction* (friction) with the road surface.
- Car tires are pneumatic, which means they are filled with air.

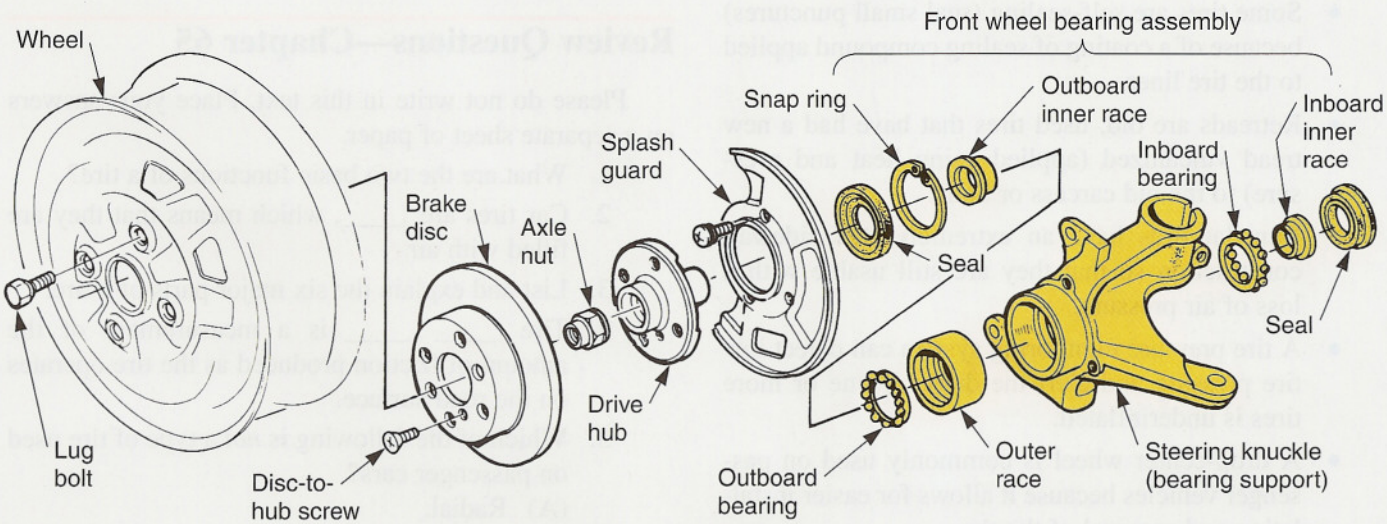

Figure 65-26. Disassembled view of a driving hub and wheel bearing assembly. Study the names of the parts. This type of assembly is commonly used on the front of front-wheel-drive vehicles. However, it can also be found on rear-engine, rear-wheel-drive sports cars. (Honda)

- Today's vehicles use tubeless tires, which do *not* have a separate inner tube. The tire and wheel form an airtight unit.
- Tire rolling resistance is a measurement of the amount of friction produced as the tire operates on the road surface.
- A bias ply tire has plies running at an angle from bead to bead.
- A belted bias tire is a bias tire with belts added to increase tread stiffness.
- A radial ply tire has plies running straight across from bead to bead with stabilizer belts directly beneath the tread.
- Tire markings on the sidewall of a tire give information about tire size, load carrying ability, inflation pressure, number of plies, identification numbers, quality ratings, and manufacturer.
- Tire size is given on the sidewall as a letter-number sequence.
- The aspect ratio, or height-to-width ratio, is a comparison of the tire's height and width.
- The maximum load rating of a tire indicates the amount of *weight* the tire can carry at recommended inflation pressure.
- The maximum inflation pressure, printed on the tire sidewall, is the highest air pressure that should be pumped into the tire.
- A tire speed rating is the maximum allowable sustained road speed the tire can safely withstand without failure.
- Some tires are self-sealing (seal small punctures) because of a coating of sealing compound applied to the tire liner.
- Retreads are old, used tires that have had a new tread vulcanized (applied using heat and pressure) to the old carcass or body.
- Run-flat tires have an extremely stiff sidewall construction so that they are still usable with a loss of air pressure.
- A tire pressure monitoring system can detect low tire pressure and alert the driver if one or more tires is underinflated.
- A drop-center wheel is commonly used on passenger vehicles because it allows for easier installation and removal of the tire.
- A valve stem snaps into a hole in the wheel of a tubeless tire to allow inflation and deflation.
- Lug nuts hold the wheel and tire assembly on the vehicle.
- Wheel weights are small lead weights attached to the wheel rim to balance the wheel-and-tire assembly and prevent vibration.

Important Terms

Tires
Pneumatic
Tubeless tires
Beads
Body plies
Tread
Sidewall
Belts
Liner
Tire rolling resistance
Bias ply tire
Belted bias tire
Radial ply tire
Tire markings
Tire size
P-metric
Alpha-numeric
Aspect ratio
Maximum load rating
Maximum inflation pressure
DOT serial number
Tread wear
Tire traction
Tire temperature resistance
Tire speed rating
Asymmetric tires
Directional tires
Hydroplaning
Spare tire
Self-sealing
Run-flat tires
Wear bars
Tire pressure monitoring system
Wheels
Drop-center wheel
Safety rim
Valve stem
Valve core
Lug nuts
Lug studs
Lug bolts
Wheel weights
Wheel bearings
Hub and wheel bearing assembly

Review Questions—Chapter 65

Please do not write in this text. Place your answers on a separate sheet of paper.

1. What are the two basic functions of a tire?
2. Car tires are _____, which means that they are filled with air.
3. List and explain the six major parts of a tire.
4. Tire _____ _____ is a measurement of the amount of friction produced as the tire operates on the road surface.
5. Which of the following is *not* a type of tire used on passenger cars?
   (A) Radial.
   (B) Bias ply.
   (C) Lateral ply.
   (D) Belted bias.
6. What information is commonly given on the tire sidewall?

7. A typical tire inflation pressure would be 22 psi (152 kPa). True or False?
8. How does a self-sealing tire work?
9. A(n) _____ _____ has small ridges that hold the tire on the wheel during a blowout.
10. Explain why a valve core is needed.
11. _____ _____ are attached to the rim to balance the wheel-and-tire assembly and prevent vibration.
12. Name and describe the basic parts of a wheel bearing.
13. List and explain the nine basic parts of a hub and tapered roller bearing assembly.
14. List and explain the seven basic parts of a hub and ball bearing assembly.
15. A sealed hub and bearing assembly is not serviceable. True or False?

ASE-Type Questions

1. Technician A says one of the functions of an automotive tire is to provide a cushion between the road and the metal wheel. Technician B says one of the functions of an automotive tire is to provide adequate traction with the road surface. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.
2. Technician A says automotive tires are pneumatic. Technician B says modern automotive tires are not pneumatic. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.
3. Technician A says older vehicles used tires equipped with inner tubes. Technician B says vehicles always came from the factory equipped with tubeless tires. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.
4. Technician A says an automotive tire's beads are used to stiffen the tire treads. Technician B says an automotive tire's beads are used to hold the sidewalls against the wheel rim. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.
5. Technician A says an automotive tire's body plies provide a leakproof membrane for modern tubeless tires. Technician B says an automotive tire's liner provides a leakproof membrane for modern tubeless tires. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.
6. Technician A says an automotive tire's belts form the body of the tire. Technician B says an automotive tire's belts are sometimes used to strengthen the plies and stiffen the treads. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.
7. Technician A says tire "rolling resistance" is normally reduced by lower inflation pressure. Technician B says tire "rolling resistance" is normally reduced by higher inflation pressure. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.
8. Technician A says "belted bias" tires provide a smooth ride and good traction. Technician B says "radial" tires have a very stable footprint. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.

9. Technician A says a "bias ply tire" is one of the newest tire designs and is equipped with belts. Technician B says a "bias ply tire" is one of the oldest tire designs and does not use belts. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.
10. Technician A says a radial ply tire's belts are sometimes made of steel. Technician B says a radial ply tire's belts are sometimes made of fiberglass. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.
11. Technician A says tire markings on the sidewall of a tire give information about tire load-carrying ability. Technician B says tire markings on the sidewall of a tire provide the maximum recommended inflation pressure. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.
12. Technician A says most automotive wheels are made of steel. Technician B says most automotive wheels are made of aluminum. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.
13. Technician A says wheel bearings in several car models are the tapered roller bearing type. Technician B says wheel bearings in certain car models are the ball bearing type. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.
14. While discussing the basic parts of an automotive wheel bearing, Technician A says the bearing's outer race is sometimes pressed into the automobile's steering knuckle. Technician B says a wheel bearing's outer race is sometimes pressed into the hub. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.
15. Technician A says a steering knuckle is a basic component in a driving hub and wheel bearing assembly. Technician B says an inner drive axle is a basic component in a driving hub and wheel bearing assembly. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.

Activities—Chapter 65

1. Using a section of an old worn tire, prepare a cutaway teaching aid showing the different parts and layers of the tire.
2. Prepare an overhead transparency that explains tire and wheel sizes and tire ratings.
3. As a classroom demonstration, disassemble and identify the parts of a hub.